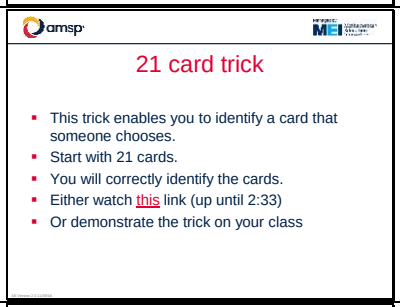
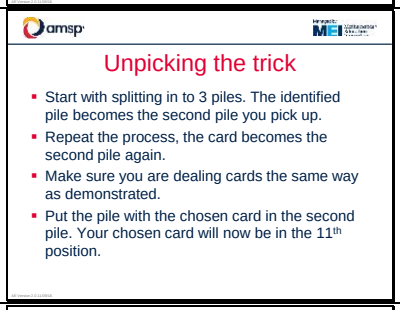
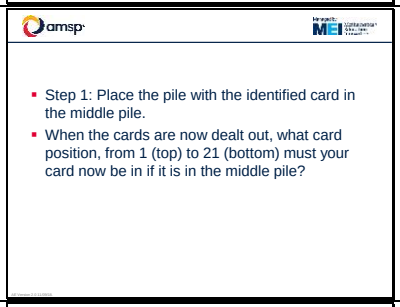
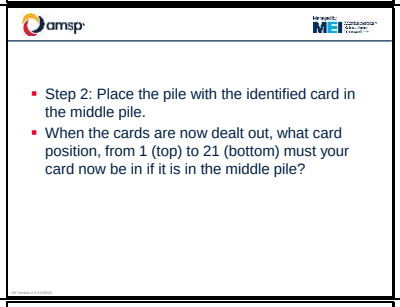
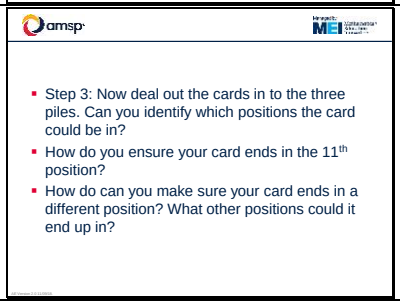
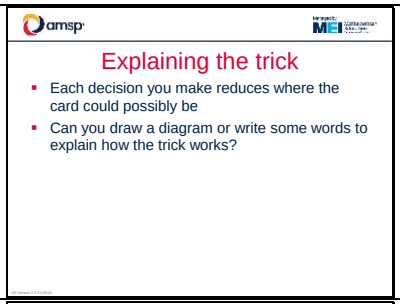
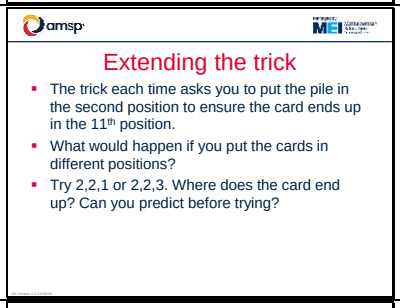
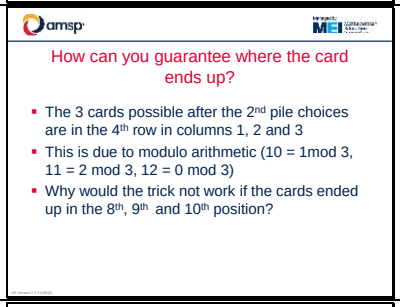
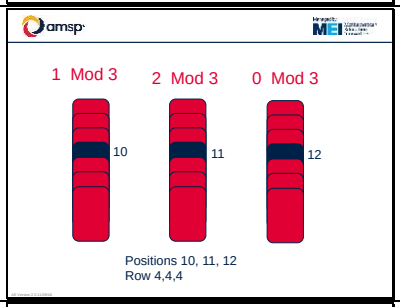
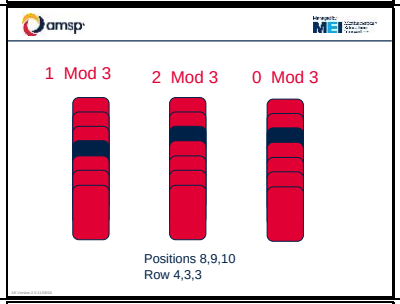
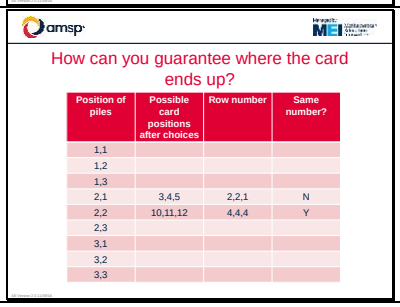
Slide 1		
Slide 2		The 21 card trick is a well known mathematical card trick. There are lots of youtube videos that could be shown. It is a trick that works easily in a class as the volunteer can clearly show everyone what the card is they have chosen before shuffling in. Invite other students to shuffle the pack to ensure that they see it truly is shuffled. How clear you are with the mechanics when demonstrating is down to choice!
Slide 3		You could now give 21 cards to each group of students and ask them to carry out the trick, slowly going through each step. Ensure they are dealing the cards out as demonstrated (pile 1,2,3,1,2,3,1,2,3…. in order). If you showed the numberphile video – as how the 11th position linked to the end of her trick – removing piles so that she ended with the 11th card.
Slide 4		Now students might want pen and paper, or time to discuss. We talk about positions – this means from when you dealt the cards (the first card is in position 1, second card position 2 etc). After step 1 the cards will be in positions 8 – 14.
Slide 5		This now depends on which pile the students have chosen. As we are dividing 7 in to 3 piles, they would either be in position 10 and 11, 10, 11 and 12 or 11 and 12.
Slide 6		As the card will always be 4th in the column, if you put it in the second pile the card will always end up in the 11th position.

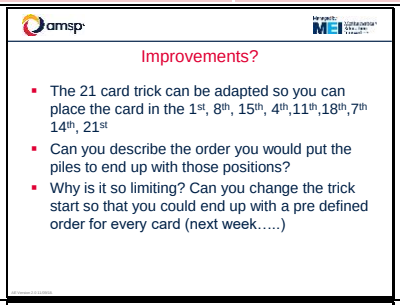
Slide 7		A tree diagram or flow chart could work.
Slide 8		Students can use cards to follow the trick. Eventually they may be able to visualise the answers but some may use cards all the way through. Patterns are most obvious linking the final positions on whether you first select the 1st pile 2nd pile or 3rd pile. You can generate linear sequences from your answers.
Slide 9		If the cards end up in the 8th, 9th and 10th position they are in different positions in the columns – 4th, 3rd and 3rd. So you then can't guarantee that the card will end up in a certain position when dealing out the cards.
Slide 10		This is the original 21 card trick (so 2nd then 2nd pile).
Slide 11		This arrangement is from 1st pile then 2nd pile.
Slide 12		This trick only works if the column positions are the same for all 3 cards. This only works if you choose the same pile position both times, so 1,1 2,2 or 3,3. If you don't do that then you would have to memorise or have a system to work out which row the card would be in depending on the final column selection.

Position of piles	Possible positions after choices	Column positions	Same number?
1,1	1,2,3	1,1,1	Y
1,2	8,9,10	3,3,4	N
1,3	15,16,17	5,6,6	N
2,1	3,4,5	2,2,1	N
2,2	10,11,12	4,4,4	Y
2,3	17,18,19	6,6,7	N
3,1	5,6,7	2,2,3	N
3,2	12,13,14	4,5,5	N
3,3	19,20,21	7,7,7	Y

First position is 7n-6

First position is 7n-4

First position is 7n-2

Slide 13		111;112;113;221;222;223;331;332;333 The most obvious extension is to take the task and make it 27 cards. That way it is divisible by 3 so the positions of the cards will always be in the same row after 3 iterations of the dividing. This is explored in the next activity in this series.
Slide 14